Space Weather Technical Forecast

Issued on Monday, 06 November 2023 at 13:27 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Risk of G1/Minor Storms either late 06 Nov or on 07 Nov. Chance of M-class flares.

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Moderate, with one M1.6 flare emitted from AR3480 at 05/1432 UTC, along with a series of mid-range C-class flares. AR3477 is the other significant region on the visible disc, but appears large and mature with limited signs of activity. The remaining three regions all appear weak and benign. No Earth-directed CMEs have been observed on available imagery.

Solar Wind / Geomagnetic Activity: Residual effects of the recent CMEs are being observed at L1, with solar wind speeds between 450-500 km/s on a generally declining trend. Density is also following a declining trend, from a peak of 32 ppcc, falling to 7 ppcc by the end of the period. Total magnetic field strength (IMF) has eased from a peak of around 40 nT to 13nT as the Earth moves out of the magnetic cloud associated with the CMEs. The north-south component of the magnetic field initially varied strongly, with positive and negative peaks of +/-20 nT, but the fluctuations have eased back to moderate oscillations. Phi angle has been predominantly negative (towards the Sun), with only brief incursions into the positive sector. Geomagnetic activity started at G1/Minor Storm or G2/Moderate Storm levels due to the effects of the CMEs, with two G3/Strong Storm intervals between 06/1500-2100 UTC. Activity reduced to mainly Active levels from 06/0000 UTC, with only one G1/Minor Storm interval.

Energetic Particles / Solar Radiation: GOES16 high energy (greater than 10MeV) proton flux has eased back to background levels over the last 24 hours. GOES16 high energy (greater than 2MeV) electron flux was background. The associated 24-hour fluence started slightly above the Active threshold, but has since fallen below the Active (1e8 integrated pfu) threshold from 05/1500 UTC. The fluence observation at 06/0000 UTC was 1.09e6 integrated pfu.

Four-Day Space Weather Forecast Summary
Solar Activity: Low solar activity is expected through the next four days, with a risk of isolated Moderate activity, mainly from AR3477 and AR3480.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs are forecast through the forecast period. A high speed stream from coronal hole 67 is the forecast to connect with the Earth, either late on 06 Nov or during 07 Nov, with speeds of around 500-600 km/s expected to then continue until at least 08 Nov. Geomagnetic activity will start mainly Unsettled to Active, but then decline ahead of the onset of the high speed stream. This could lead to isolated G1/Minor Storm intervals, with a decline to Unsettled to Active and then mainly Unsettled through the period.

Energetic Particles / Solar Radiation: High energy (greater than 10MeV) proton flux is expected to continue at background levels. High energy electron flux (greater than 2MeV), is likely to slowly increase towards Moderate or High after CME effects and the coronal hole high speed stream eases later in the period. Associated 24-hour electron flux may become enhanced toward the end of the period as the high speed stream eases, though timings on this occurring is considered to be low confidence.

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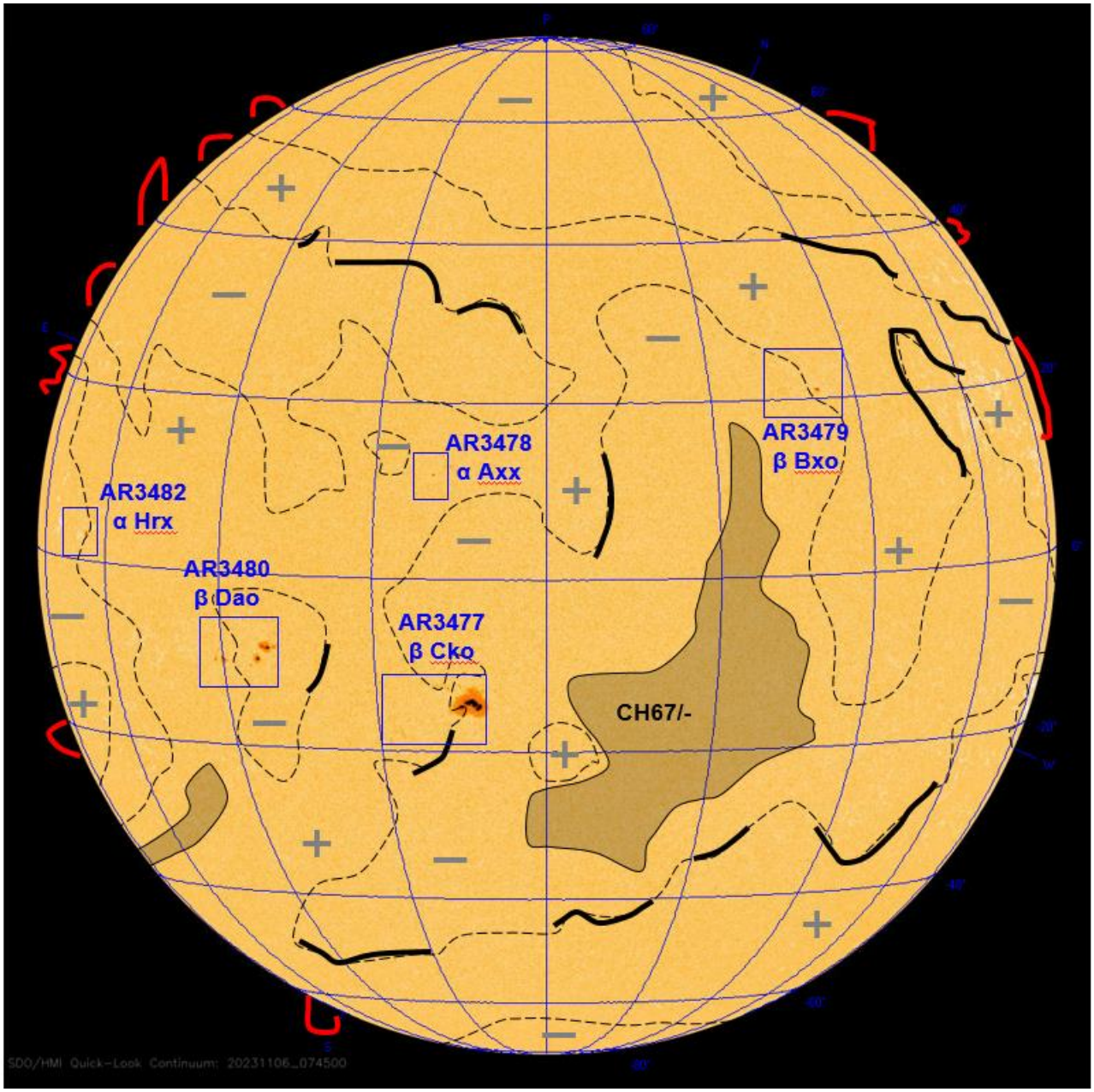
Figure 1. Solar Analysis Valid 06/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:
Following the three CME in the last 48 hours, no further CMEs are forecast within the next four days.

Solar wind speeds are at slightly elevated levels, around 450-500 km/s as the effects of the recent CME arrivals decline. This decline is expected to continue through the next 24 hours. The high speed stream from coronal hole 67 is the expected to connect with the Earth, either from late on 06 Nov, or during 07 Nov, with speeds estimated at around 600km/s. On the last rotation, the coronal hole produced speeds of around 500 km/s, but is larger on this rotation. A CIR (co-rotating interaction region) was also observed, with a similar feature likely on this occasion.

Geomagnetic activity is expected to start mainly Active as the residual activity from the CMEs due to the disturbance of the magnetic field. Activity is then likely to increase again either later on 06 or during 07 Nov as the high speed stream from coronal hole 67 is forecast to connect with the Earth. Active to G1/Minor Storm intervals are possible at the onset of the coronal hole, with a decreasing risk through the following days.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	**G1 to G2**	Yes	60	40	10	1
Strong	**G3**	No	1	1	1	1
Severe	**G4**	No	1	1	1	1
Extreme	**G5**	No	1	1	1	1

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Figure 2: Recent solar wind observations, the increase at the end of the period may be an early onset of the high speed stream mentioned in the text.

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Radio Blackouts - X-Ray Flares:

Low activity is expected, with a chance of isolated Moderate activity, mainly from two large and relatively complex sunspot regions in the eastern hemisphere. AR3480 has been the most active region and has produced a M-class flare in the last 24 hours. AR3477 is the largest region, but appears to be mature and comparatively inactive. The remaining regions all appear simple and benign, with no further regions due to rotate into the visible side of the Sun.

AR3472 and AR3474 are close to or just beyond the western limb, but as they appeared complex on the last meaningful analysis a risk of significant flares is maintained from beyond the western horizon.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	30	30	30	30
Very Active	R3 to R5 X Class	No	5	5	5	5

Solar Radiation Storms - (High Energy Protons):

The high energy (greater than 10MeV) proton flux observed by GOES16 is expected to persist at mainly background levels. The main source of any enhancement is likely to be from any filament eruptions or from any more significant flares. There are no significant sunspots in the western hemisphere, but AR3477 and AR3480 will continue to be monitored for potential developments.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	5	5	5	5
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons Event (≥ 2MeV):
High energy electron flux (greater than 2MeV) is expected to be at background levels for much of the period. This may continue to be further suppressed by the solar wind pressure from the high speed stream either later on 06 or during 07 Nov distorting the radiation belts from the position of GOES16. A sharp recovery is the possible later on 09 Nov as the solar wind eases and the radiation belts relax, with moderate or high levels possible.

Associated 24-hour electron flux is expected to be below the Active threshold through much of the period, with a slight risk of trending back towards the threshold by the end of 09 Nov as the electron flux increases.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^{8}$	Yes	1	1	10	20
Very Active	≥ 2 MeV ≥ $1x10^{9}$	No	1	1	1	1

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